

located. That information may either be provided by means of a building name, where the antenna cell site sector antenna is located, a street address, or in the preferred embodiment, by means of a latitude and longitude coordinates provided by a global positioning system. The GPS system is used by tracking vehicle 47 to establish its position with respect to the cell site sector that has been identified.

Once the identity and general location of the stolen vehicle is received at the tracking vehicle 47, the tracking vehicle can monitor the open voice channel 46 and travel in the general direction identified by the security service provider. Once the tracking vehicle 47 reaches the general location of the stolen vehicle, the security response team makes use of a radio direction finder which is tuned to the voice channel 46 to precisely identify the location of the stolen vehicle. Once the precise location of the stolen vehicle has been confirmed, the security response team can alert the authorities to recover the vehicle.

The tracking vehicle 47 is provided with a cellular telephone system to communicate with the security service provider 44. The radio direction finder consists of a number of antennae 49 connected to radio direction finder equipment to locate precisely the direction of arrival of an RF signal emitted by the stolen vehicle on the voice channel 46 and received by cell site A as well as tracking vehicle 47.

Referring now to FIG. 4a, we have shown a block diagram of the vehicle tracking equipment which is provided in the tracking vehicle and which is used by the security response team to track the precise location of the stolen vehicle. The equipment includes a standard cellular transceiver 50 which enables the security response team to communicate with the security service provider to coordinate the search and tracking of the stolen vehicle. As indicated above, the vehicle may be provided with a GPS antenna 51 connected to a GPS receiver 52 and computer 53 to enable the operator to determine the location of the tracking vehicle with respect to the coordinates of the cell site communicating with the stolen vehicle. GPS receiver 52 will provide a direction the tracking vehicle should follow in order to reach the cell site. This is achieved by entering the coordinates of the cell site. The GPS receiver 52 can then provide an indication of the route to follow to the tracking vehicle which receives positioning data from a satellite via GPS antenna 51.

Once the tracking vehicle is dispatched and rolling towards the cell site serving or communicating with the cellular transceiver of the stolen vehicle, the specialized cellular band RF receiver 55 locks onto the forward voice channel 41 (the frequency used to communicate from the tower to the cellular transceiver) currently in use based on the combination of ESN and NAM or a specified channel pointed out by the operators at the MTSO. The four quarter wave antenna of the radio direction finder 56 can then determine the direction of arrival of the RF signal emitted by the cellular tower. This provides the recovery team with a bearing towards the cell tower A (FIG. 3b) if necessary. Once in the vicinity, the RF receiver is set to the reverse voice channel (the frequency used to communicate from the cellular transceiver to the tower) 41. This is done by dropping the frequency by exactly 45 Mhz. on the tuner. The information provided by the quarter wave antennae 57 can then be used at a display or monitor 58 to determine the exact location of the stolen vehicle. As shown in FIG. 4b, the four quarter wave antennae are mounted at the corners of a square on the roof of a tracking vehicle 47. The output of each of the quarter wave antennae are fed into an antenna adder/coupler 59 and applied to the input of RF receiver 55.

A radio direction finder such as described above is available from Doppler Systems Inc.

The cellular tracking system as identified at reference numeral 54 is available from Allen Telecom Group Inc.

We claim:

1. A method of locating a stolen vehicle provided with a locating cellular transceiver, using the existing cellular network infrastructure, comprising the steps of:

receiving an indication that said vehicle has been stolen; receiving transmitted signals from said cellular transceiver at one or more cell sites within operational range of said cellular transceiver, establishing and maintaining an open voice channel with said locating cellular transceiver of said stolen vehicle;

determining a cell site sector within said network in which the stolen vehicle is located based on the location of said one or more cell sites communicating with said locating cellular transceiver;

determining a general geographical location of a search vehicle with respect to said one or more cell sites;

despatching said search vehicle to said cell site sector of said stolen vehicle and monitoring said open voice channel from said search vehicle; and

locating said stolen vehicle based on the direction of arrival of RF signals emitted by said cellular transceiver in said stolen vehicle and received at said search vehicle.

2. A method as defined in claim 1, further comprising the step of querying the cellular network for the general location of said stolen vehicle, based on the last known location of said vehicle in said cellular network.

3. A method as defined in claim 2, wherein said step of querying comprises determining the Electronic Serial Number (ESN) of said locating cellular transceiver associated with said stolen vehicle and assigning said ESN with a predetermined Number Assigned Mobile (NAM) such that the locating cellular transceiver associated with the stolen vehicle can be paged by said existing cellular network.

4. A method as defined in claim 1, wherein said search vehicle monitors the transmit frequency of said open voice channel.

5. A method as defined in claim 4, wherein said search vehicle locates said stolen vehicle using a radio frequency direction finder tuned to said transmit frequency of said open voice channel.

6. A method as defined in claim 5, wherein said locating cellular transceiver is on a full-time standby mode until an indication that said vehicle has been stolen is received.

7. A method as defined in claim 6, wherein said locating cellular transceiver is switched to an active mode to open said voice channel, until said stolen vehicle is located.

8. A method as defined in claim 1, wherein the location of said search vehicle with respect to said one or more cell sites is determined by downloading the longitude and latitude coordinates of one of said sites into a GPS receiver mounted on said search vehicle.

9. A system for locating a stolen vehicle provided with a locating cellular transceiver, said system operating using the existing cellular network infrastructure, comprising:

means for receiving an indication that said vehicle has been stolen;

cellular radio means for maintaining an open voice channel with said locating cellular transceiver of said stolen vehicle;

means for determining a cell site sector within said network in which the stolen vehicle is located based on

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the location of one or more cell sites communicating with said locating cellular transceiver;

locator means for determining a general geographical location of a search vehicle with respect to said one or more cell sites;

radio means for monitoring said open voice channel from said search vehicle; and

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radio location finder means for locating said stolen vehicle based on the direction of arrival of RF signals emitted by said cellular radio means in said stolen vehicle and received at said search vehicle.

10. A method as defined in claim 1, further comprising a step of paging said locating cellular transceiver.

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11. A method of obtaining locating information concerning a locating cellular transceiver using an existing cellular network infrastructure, comprising the steps of:

receiving transmitted signals from said cellular transceiver at one or more cell sites within operational range of said cellular transceiver;

establishing and maintaining an open voice channel with said locating cellular transceiver;

determining a cell site sector within said network in which the cellular transceiver is located based on the location of said one or more cell sites communicating with said locating cellular transceiver;

determining a general geographical location of a search vehicle with respect to said one or more cell sites;

moving said search vehicle to said cell site sector of said cellular transceiver and monitoring said open voice channel from said search vehicle; and

obtaining a direction in which said cellular transceiver is located with respect to said search vehicle based on the direction of arrival of RF signals emitted by said cellular transceiver and received at said search vehicle.

12. A method as defined in claim 11, further comprising the step of querying the cellular network for the general location of said transceiver based on the last known location of said transceiver in said cellular network.

13. A method as defined in claim 12, wherein said step of querying comprises determining an Electronic Serial Number (ESN) of said locating cellular transceiver associated with said stolen vehicle and assigning said ESN with a predetermined Number Assigned Mobile (NAM) such that the locating cellular transceiver associated with the stolen vehicle can be paged by said existing cellular network.

14. A method as defined in claim 11, wherein said search vehicle monitors the transmit frequency of said open voice channel.

15. A method as defined in claim 14, wherein said search vehicle locates said cellular transceiver using a radio frequency direction finder tuned to said transmit frequency of said open voice channel.

16. A method as defined in claim 15, wherein said locating cellular transceiver is on a full-time standby mode until an indication that said transceiver needs to be located.

17. A method as defined in claim 16, wherein said locating cellular transceiver is switched to an active mode to open said voice channel until said transceiver is located.

18. A method as defined in claim 11, wherein the location of said search vehicle with respect to said one or more cell sites is determined by downloading the longitude and latitude coordinates of one of said sites into a GPS receiver mounted on said search vehicle.

19. A method as defined in claim 11, further comprising a step of paging said locating cellular transceiver.

20. A method as defined in claim 11, further comprising a step of concealingly mounting said transceiver within a vehicle to be located if stolen, wherein said method serves to locate a stolen vehicle.

21. A method as defined in claim 20, wherein said transceiver comprises a rechargeable battery supply and is connected to a battery power supply of an engine of said stolen vehicle.

22. A method of obtaining locating information concerning a locating cellular transceiver using an existing cellular network infrastructure, said infrastructure receiving transmitted signals from said cellular transceiver at one or more cell sites within operational range of said cellular transceiver, establishing and maintaining an open voice channel with said locating cellular transceiver, determining a cell site sector within said network in which the transceiver is located based on the location of said one or more cell sites communicating with said locating cellular transceiver, the method comprising the steps of:

placing a request with said existing cellular network infrastructure to determine said cell site sector for said cellular transceiver and to maintain said open voice channel and obtaining in response to said request an identification of said cell site sector;

determining a general geographical location of a search vehicle with respect to said one or more cell sites;

moving said search vehicle to said cell site sector of said transceiver and monitoring said open voice channel from said search vehicle; and

obtaining a direction in which said transceiver is located with respect to said search vehicle based on the direction of arrival of RF signals emitted by said cellular transceiver and received at said search vehicle.

23. A method as defined in claim 22, wherein said obtaining said direction of said transceiver comprises using a radio frequency direction finder tuned to a transmit frequency of said open voice channel.

24. A method as defined in claim 22, wherein the location of said search vehicle with respect to said one or more cell sites is determined by downloading the longitude and latitude coordinates of one of said sites into a GPS receiver mounted on said search vehicle.

25. A method as defined in claim 22, further comprising the step of querying the cellular network for the general location of said transceiver based on the last known location of said transceiver in said cellular network.

26. A method as defined in claim 25, wherein said step of querying comprises determining an Electronic Serial Number (ESN) of said locating cellular transceiver associated with said stolen vehicle and assigning said ESN with a predetermined Number Assigned Mobile (NAM) such that the locating cellular transceiver associated with the stolen vehicle can be paged by said existing cellular network.

27. A method as defined in claim 22, wherein said locating cellular transceiver is on a full-time standby mode until an indication that said transceiver needs to be located.

28. A method as defined in claim 27, wherein said locating cellular transceiver is switched to an active mode to open said voice channel until said transceiver is located.

29. A method as defined in claim 22, further comprising a step of paging said locating cellular transceiver.

30. A method as defined in claim 22, further comprising a step of concealingly mounting said transceiver within a vehicle to be located if stolen, wherein said method serves to locate a stolen vehicle.

31. A method as defined in claim 30, wherein said transceiver comprises a rechargeable battery supply and is connected to a battery power supply of an engine of said stolen vehicle.